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Joint Cosmic Shear Measurements with the Keck and William Herschel Telescopes [D. J. Bacon et al.]

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abstract The recent measurements of weak lensing by large-scale structure present significant new opportunities for studies of the matter distribution in the universe. Here, we present a new cosmic shear survey carried out with the Echelle Spectrograph and Imager on the Keck II telescope. This covers a total of 0.6 square degrees in 173 fields probing independent lines of sight, hence minimising the impact of sample variance. We also extend our measurements of cosmic shear with the William Herschel Telescope (Bacon, Refregier & Ellis 2000) to a survey area of 1 square degree. The joint measurements with two independent telescopes allow us to assess the impact of instrument-specific systematics, one of the major difficulties in cosmic shear measurements. For both surveys, we carefully account for effects such as smearing by the point spread function and shearing due to telescope optics. We find negligible residuals in both cases and recover mutually consistent cosmic shear signals, significant at the 5.1σ level. We present a simple method to compute the statistical error in the shear correlation function, including non-gaussian sample variance and the covariance between different angular bins. We measure shear correlation functions for all fields and use these to ascertain the amplitude of the matter power spectrum, finding $\sigma_8 \left(\Omega_m 0.3\right)^{0.68} = 0.97 \pm 0.13$ with $0.14 < \Omega_m < 0.65$ in a ΛCDM model with $\Gamma = 0.21$. These 68% CL uncertainties include sample variance, statistical noise, redshift uncertainty, and the error in the shear measurement method. The results from our two independent surveys are both consistent with measurements of cosmic shear from other groups. We discuss how our results compare with current normalisation from cluster abundance.